Warm up

Expand and simplify the following expressions:

1. $2(\boldsymbol{a}+\boldsymbol{b})+\boldsymbol{b} =$?
2. $\frac{1}{2}(\boldsymbol{a}-\boldsymbol{b})+\boldsymbol{b} =$?
3. $\boldsymbol{a}+\frac{1}{2}(\boldsymbol{a}+\boldsymbol{b}) =$?
4. $\boldsymbol{a}-2(\boldsymbol{a}-2\boldsymbol{b}) =$?
5. $\frac{1}{3}(\boldsymbol{a}+2\boldsymbol{b})-\boldsymbol{b} =$?

Vectors Quiz!

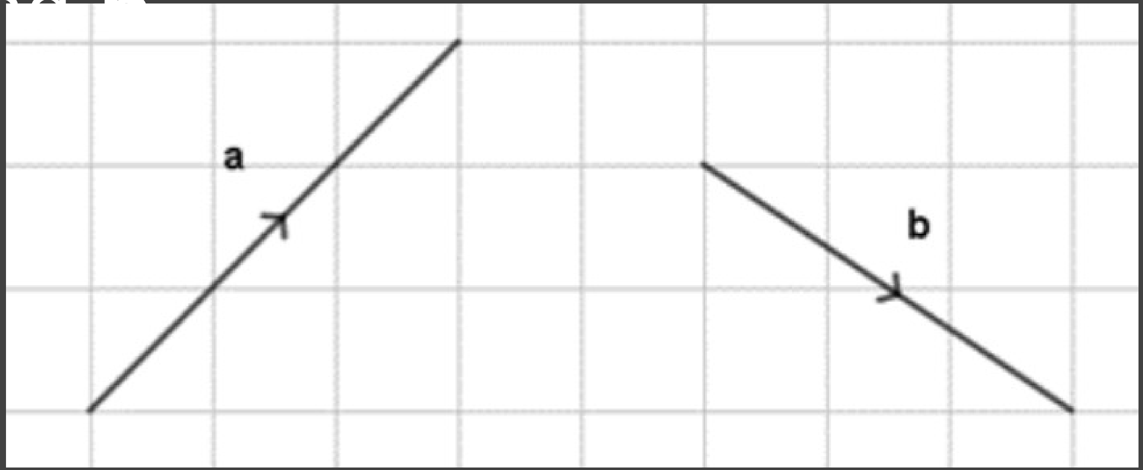
Mini whiteboards ready?

Vectors Quiz!

What is $\overrightarrow{PQ} + \overrightarrow{QR}$?

a. $\overrightarrow{RQ}$
b. $\overrightarrow{PR}$
c. $\overrightarrow{QP}$
d. $\overrightarrow{RP}$

2. This diagram shows vectors **a** and **b**



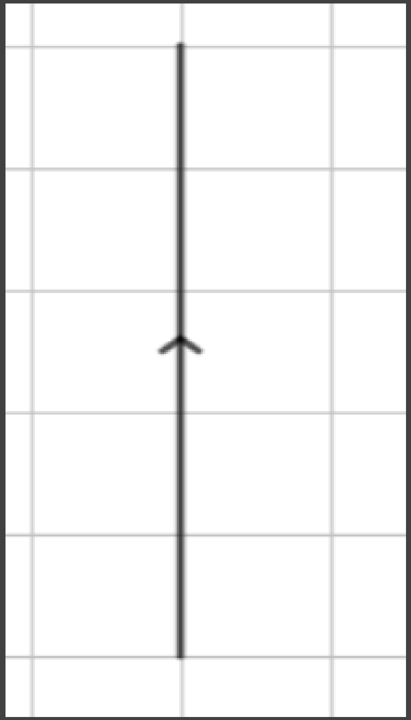
a. **a + b**

b. **a + 2b**

c. **a – b**

d. **b – a**

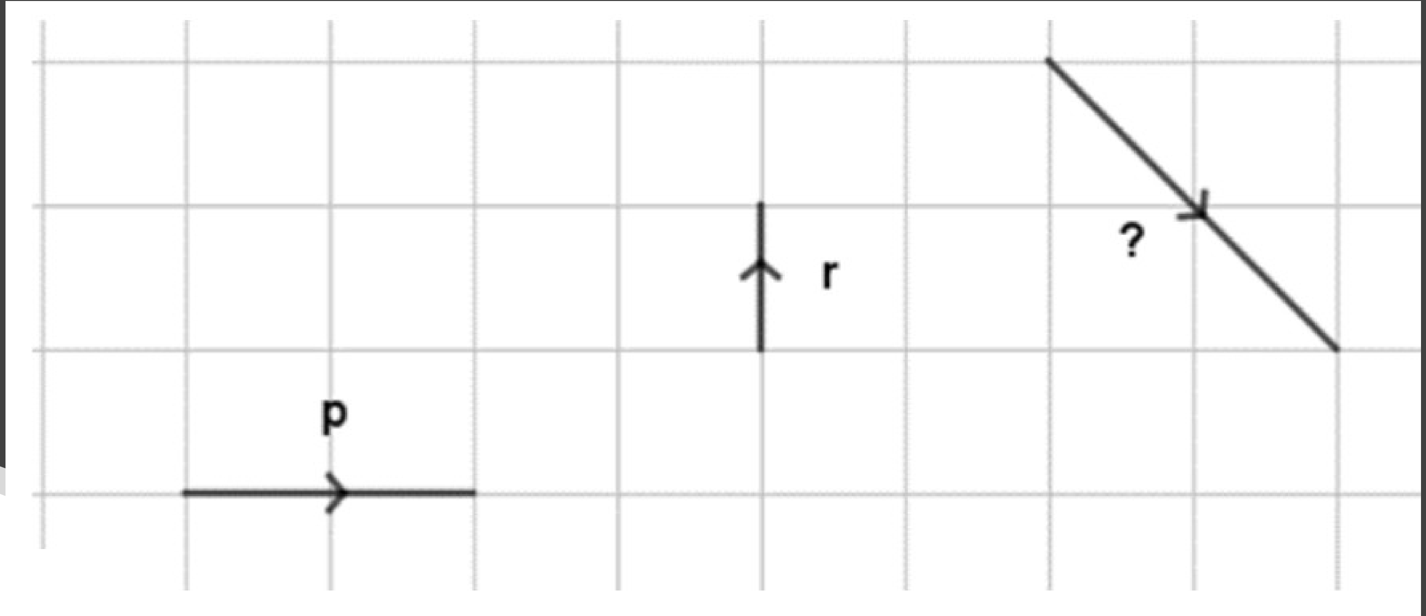
Which vector is shown in this diagram to the right?



Vectors Quiz!

If $\overrightarrow{PQ} = \boldsymbol{a}$, what is $\overrightarrow{QP}$**?**

a. $\boldsymbol{p} - \boldsymbol{q}$
b. $2\boldsymbol{a}$
c. $-\boldsymbol{a}$
d. $\boldsymbol{q} - \boldsymbol{p}$



a. p – r

b. p – 2r

c. p + 2r

d. p + r

4. What is the missing vector?

Vectors Quiz!

5. Complete this vector addition

$$\begin{pmatrix} 6 \\ -3 \end{pmatrix} + \begin{pmatrix} 4 \\ 6 \end{pmatrix} =$$

a. $\begin{pmatrix} 10 \\ 3 \end{pmatrix}$

b. $\begin{pmatrix} 24 \\ -18 \end{pmatrix}$

c. $\begin{pmatrix} 64 \\ -36 \end{pmatrix}$

d. $\begin{pmatrix} 10 \\ 9 \end{pmatrix}$

Vectors Quiz!

1) They are parallel
2) AB is k times the length of BC.

If $\overrightarrow{AB} = k\overrightarrow{BC}$, what do we know about lines AB and BC?

Write down two things.

Vectors Quiz!

a. $\begin{pmatrix} -2 \\ -2 \end{pmatrix}$

b. $\begin{pmatrix} 2 \\ -12 \end{pmatrix}$

c. $\begin{pmatrix} \frac{-3}{2} \\ \frac{7}{5} \end{pmatrix}$

d. $\begin{pmatrix} 10 \\ -2 \end{pmatrix}$

7. Complete this vector subtraction

$$\begin{pmatrix} 4 \\ 5 \end{pmatrix} - \begin{pmatrix} -6 \\ 7 \end{pmatrix} =$$

Vectors Quiz!

a. $\begin{pmatrix} 10 \\ -4 \end{pmatrix}$

b. $\begin{pmatrix} 4 \\ -7 \end{pmatrix}$

c. $\begin{pmatrix} 4 \\ 13 \end{pmatrix}$

d. $\begin{pmatrix} 25 \\ -22 \end{pmatrix}$

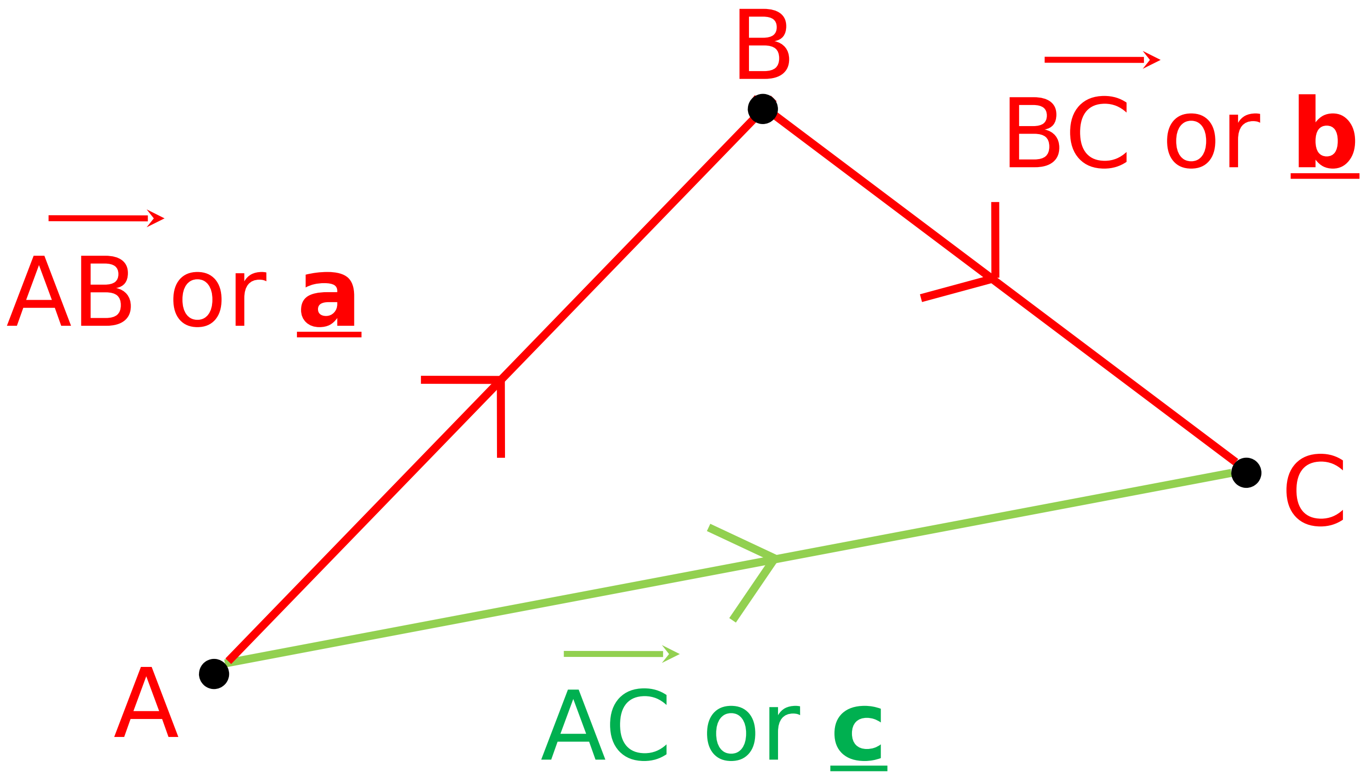
5. $\mathbf{g} = \begin{pmatrix} 3 \\ -5 \end{pmatrix}$, $\mathbf{h} = \begin{pmatrix} -2 \\ -3 \end{pmatrix}$

Work out the vector $2\mathbf{g} + \mathbf{h}$.

None of them!

$\begin{pmatrix} 4 \\ -13 \end{pmatrix}$

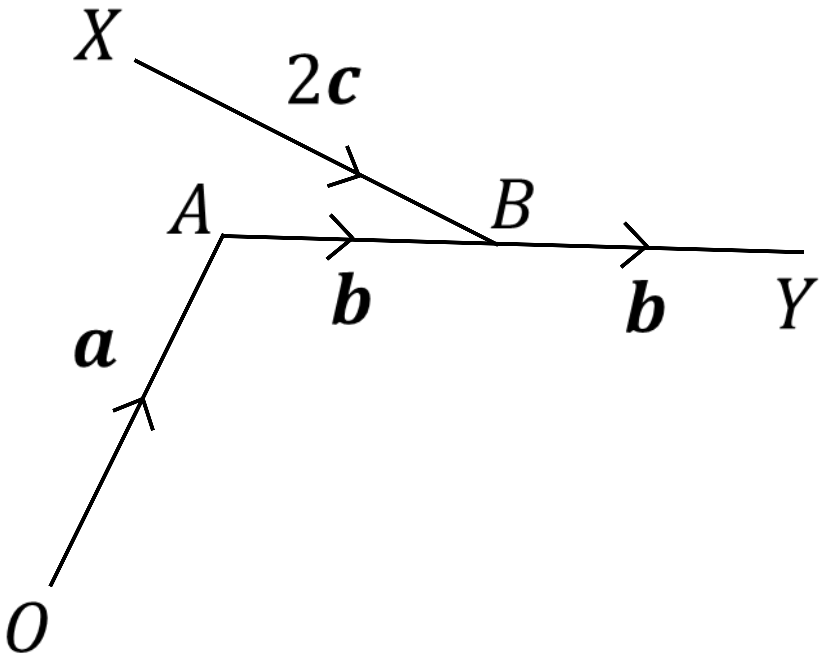
Resultant Vectors



A resultant vector is a single vector which is equivalent to a set of vectors

$\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$ or $\underline{c} = \underline{a} + \underline{b}$

Adding and Subtracting Vectors



If $\overrightarrow{OA} = \boldsymbol{a}$, $\overrightarrow{AB} = \boldsymbol{b}$ and $\overrightarrow{XB} = 2\boldsymbol{c}$, then find the following in terms of a, b and c:

$\overrightarrow{OB} =$?

$\overrightarrow{OY} =$?

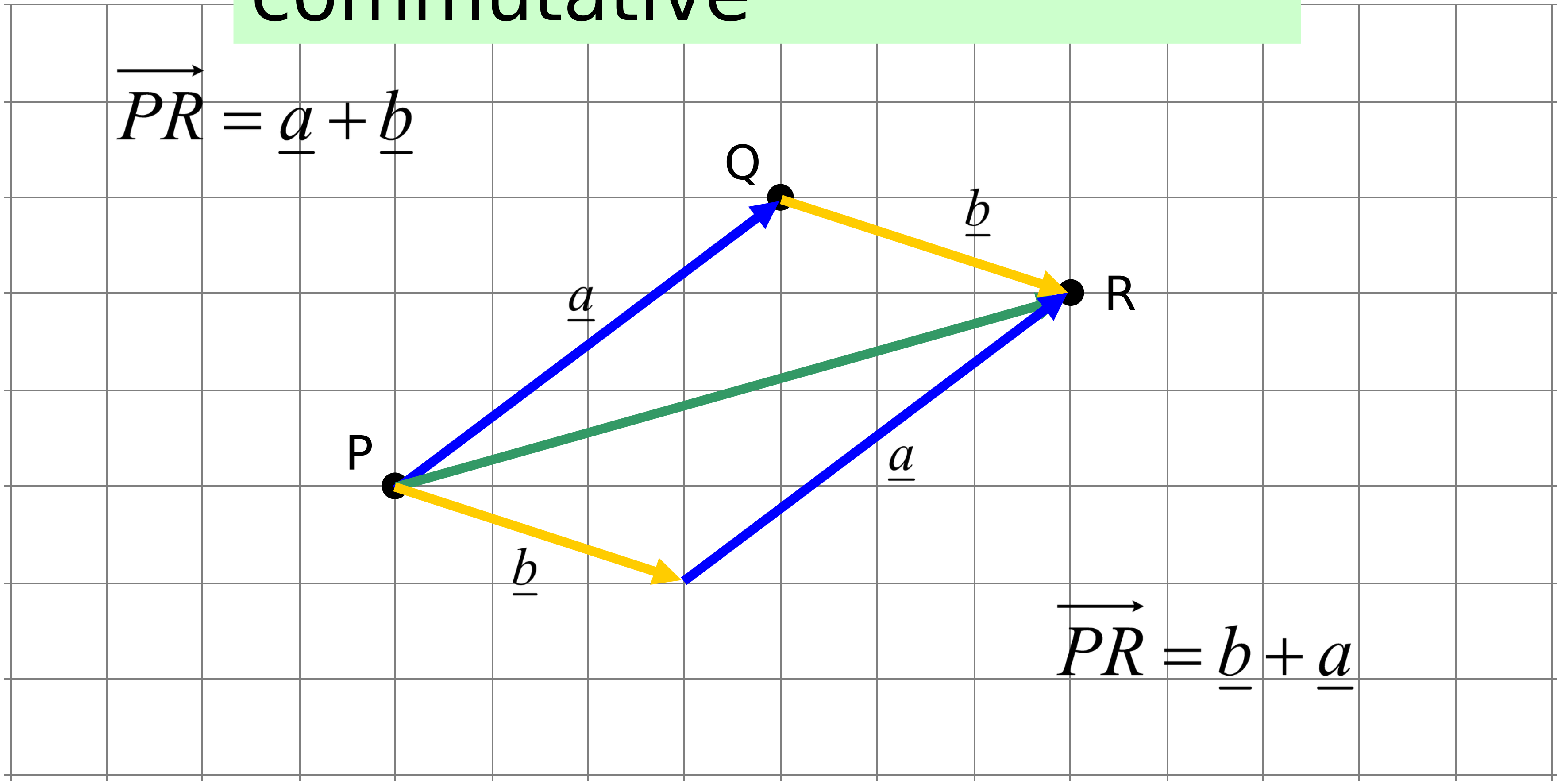
$\overrightarrow{AX} =$?

$\overrightarrow{XO} =$?

$\overrightarrow{YX} =$?

Note: to go in the opposite direction we need to subtract!

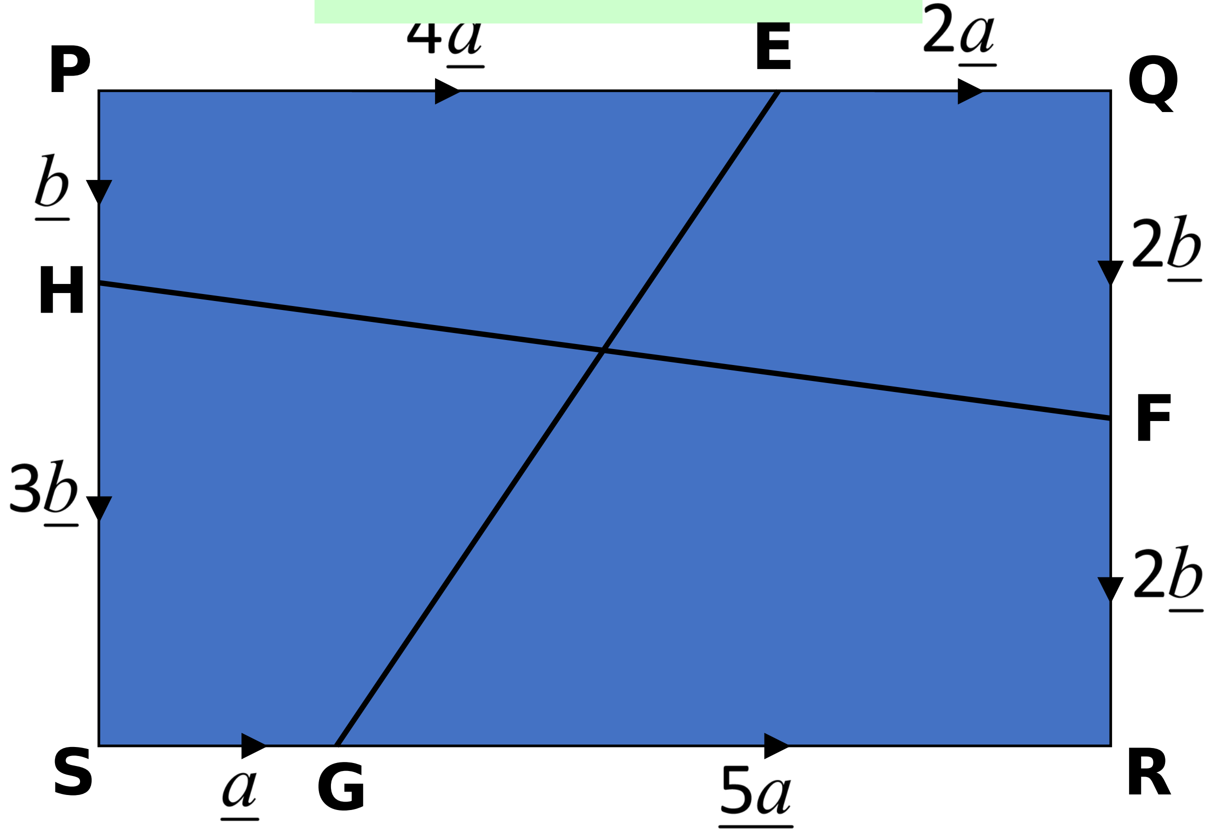
Vector addition is commutative



Like normal addition, order doesn't matter when adding vectors

$$\underline{a} + \underline{b} = \underline{b} + \underline{a}$$

Vector addition



On your mini white boards, write down vectors, in terms of $\underline{a}$ and $\underline{b}$, for:

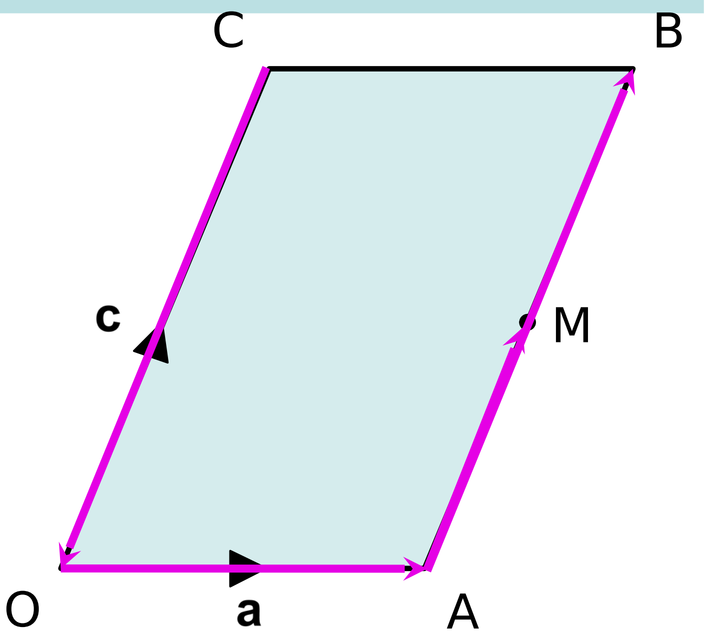
$\overrightarrow{EF}$, $\overrightarrow{PR}$, $\overrightarrow{QP}$, $\overrightarrow{EG}$, $\overrightarrow{GE}$, $\overrightarrow{RH}$, $\overrightarrow{HR}$, $\overrightarrow{SQ}$, $\overrightarrow{FH}$

Vector Geometry: problem solving

Geometric problems can be solved using the rules for adding and subtracting **vectors** and multiplying vectors by a **scalar**.

EXAMPLE

1 OABC is a parallelogram.
M is the midpoint of AB.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$
Find in terms of **a** and **c**.



a $\overrightarrow{CB} = \overrightarrow{OA} = \mathbf{a}$

b $\overrightarrow{BA} = -\overrightarrow{OC} = -\mathbf{c}$

c $\overrightarrow{OB} = \overrightarrow{OA} + \overrightarrow{AB} = \mathbf{a} + \mathbf{c}$

d $\overrightarrow{CA} = \overrightarrow{CO} + \overrightarrow{OA} = -\mathbf{c} + \mathbf{a}$

Always write the journey you will take

e $\overrightarrow{OM} = \overrightarrow{OA} + \overrightarrow{AM} = \overrightarrow{OA} + \frac{1}{2}\overrightarrow{AB} =$

Vector Geometry

Geometric problems can be solved using the rules for adding and subtracting **vectors** and multiplying vectors by a **scalar**.

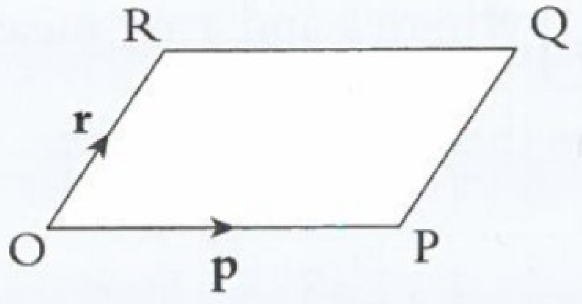
Q
1

QR is a parallelogram.

$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OR} = \mathbf{r}$.

Find the following in terms of **p** and **r**

a $\overrightarrow{RQ}$, **b** $\overrightarrow{QP}$, **c** $\overrightarrow{OQ}$, **d** $\overrightarrow{PR}$.



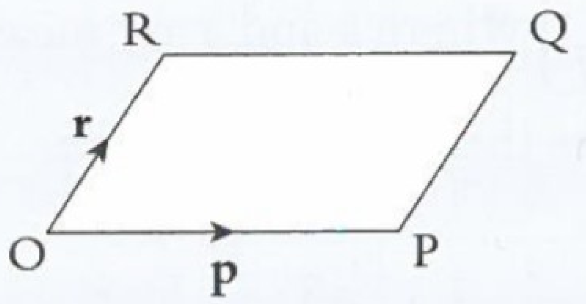
Vector Geometry

OPQR is a parallelogram.

$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OR} = \mathbf{r}$.

Find the following in terms of **p** and **r**

a $\overrightarrow{RQ}$, **b** $\overrightarrow{QP}$, **c** $\overrightarrow{OQ}$, **d** $\overrightarrow{PR}$.



a $\overrightarrow{RQ} = \mathbf{p}$

b $\overrightarrow{QP} = -\mathbf{r}$

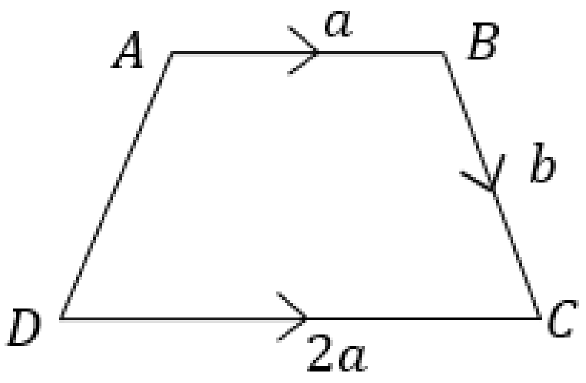
c $\overrightarrow{OQ} = \overrightarrow{OP} + \overrightarrow{PQ} = \mathbf{p} + \mathbf{r}$

d $\overrightarrow{PR} = \overrightarrow{PQ} + \overrightarrow{QR} = \mathbf{r} - \mathbf{p}$

Always write the journey you will take

Test your understanding

1



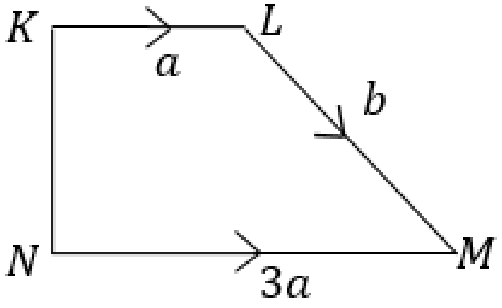
a. $\overrightarrow{BA} =$

b. $\overrightarrow{AC} =$

c. $\overrightarrow{DB} =$

d. $\overrightarrow{AD} =$

2



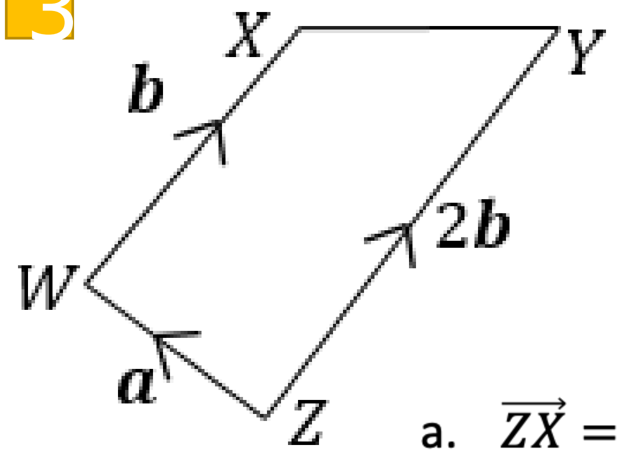
a. $\overrightarrow{MK} =$

b. $\overrightarrow{NL} =$

c. $\overrightarrow{NK} =$

d. $\overrightarrow{KN} =$

3



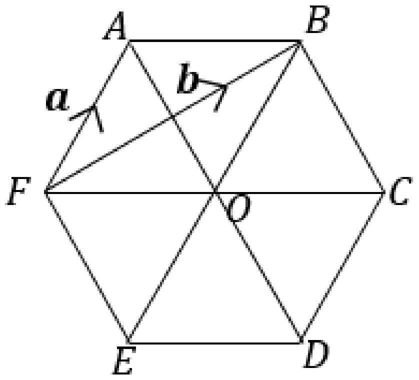
a. $\overrightarrow{ZX} =$

b. $\overrightarrow{YW} =$

c. $\overrightarrow{XY} =$

d. $\overrightarrow{XZ} =$

4



a. $\overrightarrow{AB} =$

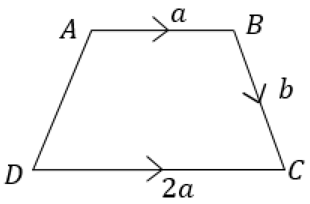
b. $\overrightarrow{FO} =$

c. $\overrightarrow{AO} =$

d. $\overrightarrow{FD} =$

Test your understading

1



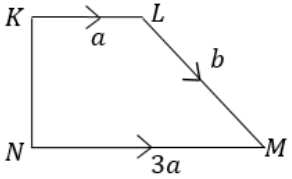
a. $\overrightarrow{BA} =$?

b. $\overrightarrow{AC} =$?

c. $\overrightarrow{DB} =$?

d. $\overrightarrow{AD} =$?

2



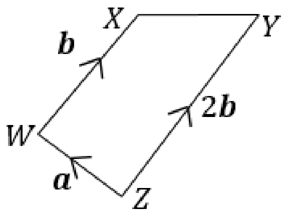
a. $\overrightarrow{MK} =$?

b. $\overrightarrow{NL} =$?

c. $\overrightarrow{NK} =$?

d. $\overrightarrow{KN} =$?

3



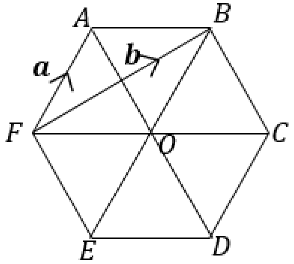
a. $\overrightarrow{ZX} =$?

b. $\overrightarrow{YW} =$?

c. $\overrightarrow{XY} =$?

d. $\overrightarrow{XZ} =$?

4



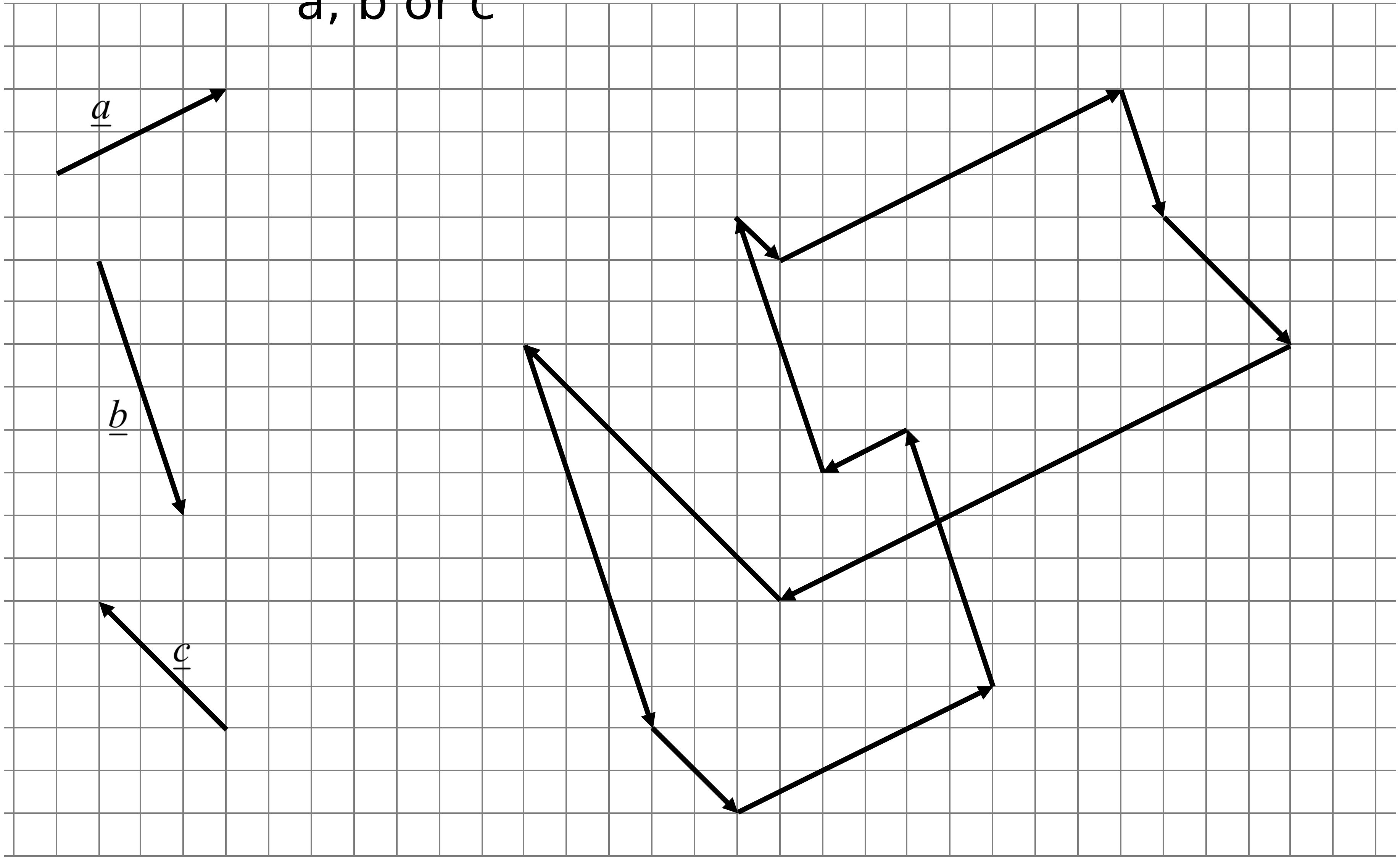
a. $\overrightarrow{AB} =$?

b. $\overrightarrow{FO} =$?

c. $\overrightarrow{AO} =$?

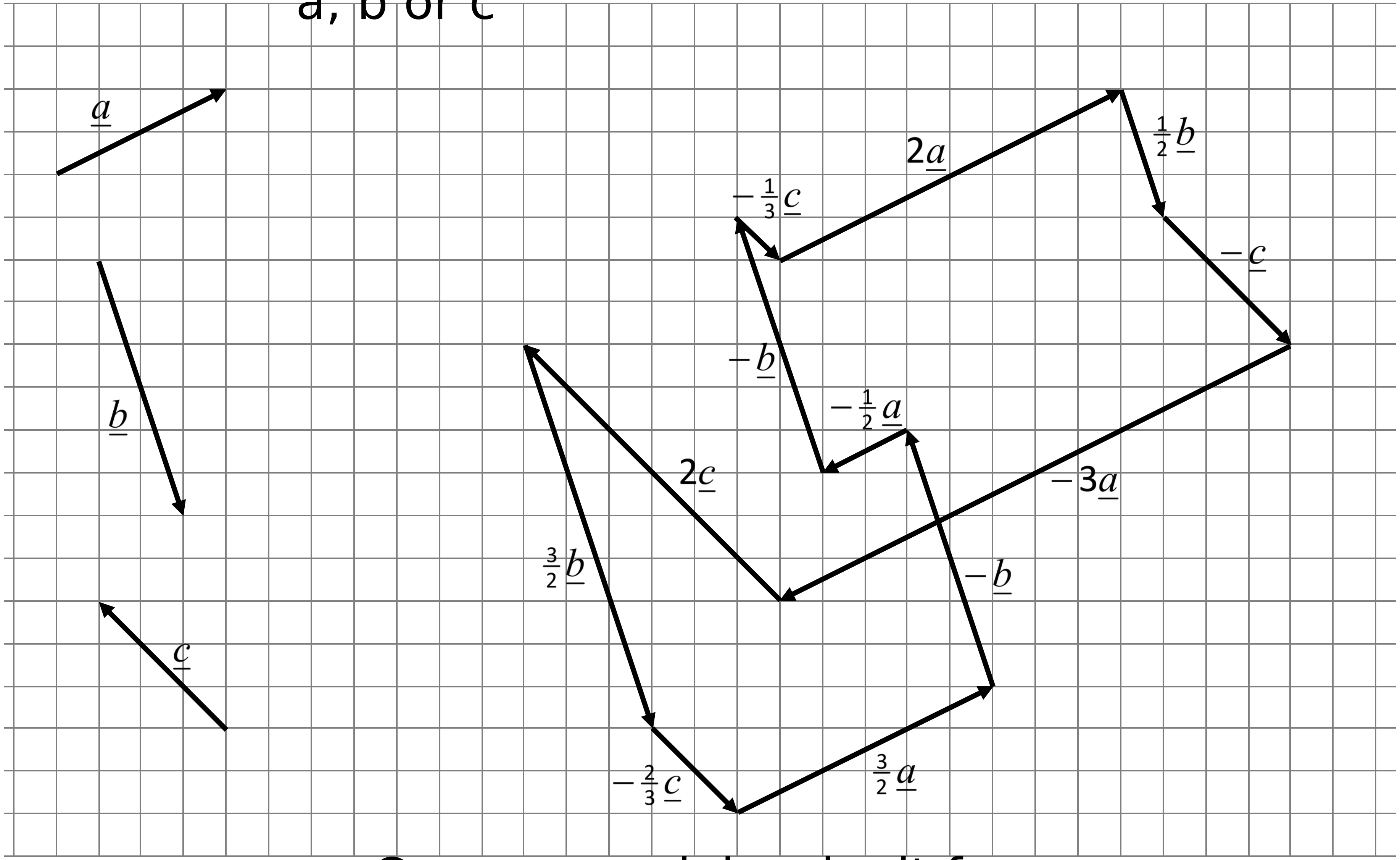
d. $\overrightarrow{FD} =$?

Label all vectors as multiples of a, b or c



Can you explain why it forms a loop?

Label all vectors as multiples of a, b or c



Can you explain why it forms a loop?

$2\underline{a} - 3\underline{a} + \frac{3}{2}\underline{a} - \frac{1}{2}\underline{a} = 0$

$\frac{1}{2}\underline{b} + \frac{3}{2}\underline{b} - \underline{b} - \underline{b} = 0$

$-\underline{c} + 2\underline{c} - \frac{2}{3}\underline{c} - \frac{1}{3}\underline{c} = 0$

Vector Geometry - midpoints

Q 2

P and Q are the midpoints of sides OA and OB.

$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OQ} = \mathbf{q}$

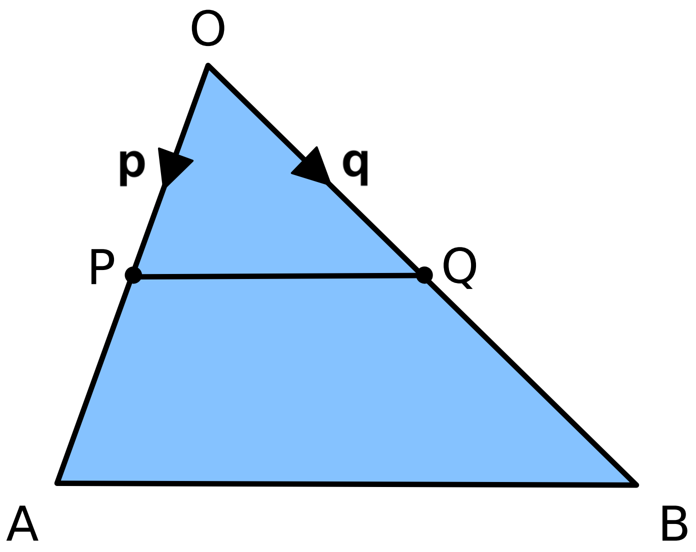
Find in terms of **p** and **q**.

a $\overrightarrow{OA}$

b $\overrightarrow{BA}$

c $\overrightarrow{AQ}$

d $\overrightarrow{PB}$



Always write the journey you will take

Vector Geometry - midpoints

Q 2

P and Q are the midpoints of sides OA and OB.

$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OQ} = \mathbf{q}$

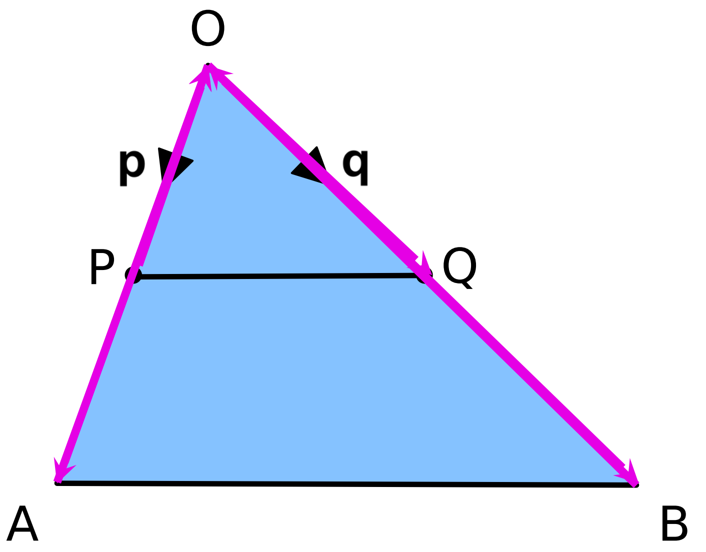
Find in terms of **p** and **q**.

a $\overrightarrow{OA} = 2\mathbf{p}$

b $\overrightarrow{BA} = \overrightarrow{BO} + \overrightarrow{OA} =$ $-2\mathbf{q} + 2\boldsymbol{p}$

c $\overrightarrow{AQ} = \overrightarrow{AO} + \overrightarrow{OQ} = -2\mathbf{p} + \mathbf{q}$

d $\overrightarrow{PB} = \overrightarrow{PO} + \overrightarrow{OB} = -\mathbf{p} + 2\mathbf{q}$



Always write the journey you will take

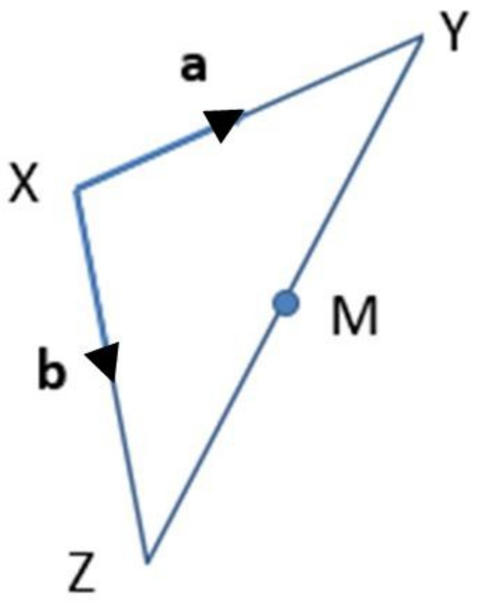
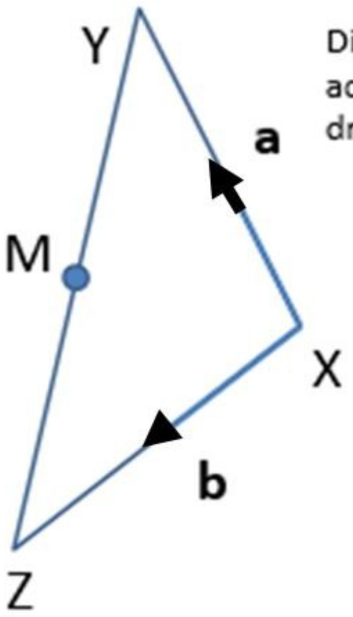


Diagram not accurately drawn

M is the midpoint of Y and Z

Find the vector YM



M is the midpoint of Y and Z

Step 1: Find the vector $\overrightarrow{ZY}$

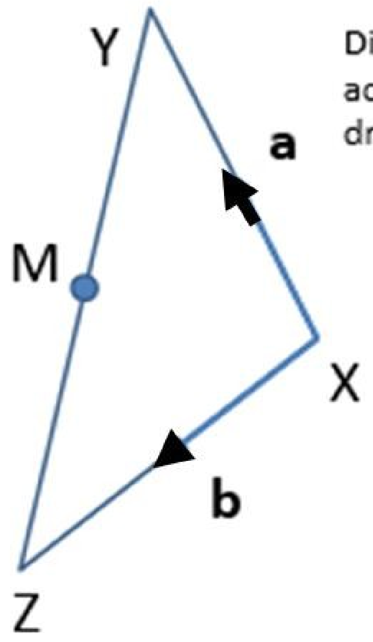
A $-\boldsymbol{b}+\boldsymbol{a}$

B $-\boldsymbol{a}+\boldsymbol{b}$

C $\boldsymbol{a}+\boldsymbol{b}$

D $-\boldsymbol{a}-\boldsymbol{b}$

Eedi



M is the midpoint of Y and Z

Vector $\overrightarrow{ZY} = -\boldsymbol{b} + \boldsymbol{a}$

Step 2: Find vector $\overrightarrow{ZM}$

A Both B and C are correct

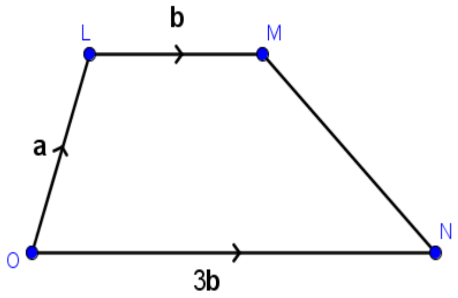
B $\frac{1}{2}(\boldsymbol{b} - \boldsymbol{a})$

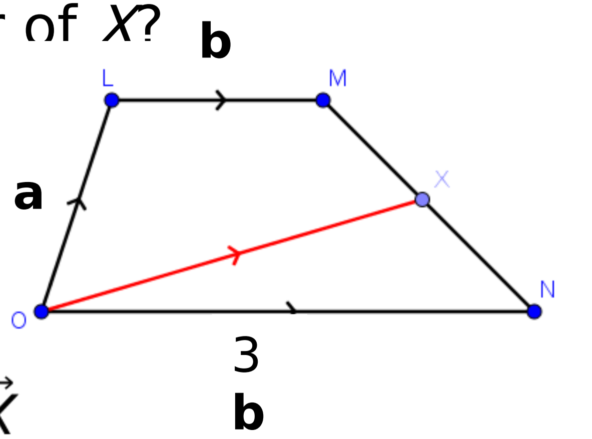
C $\frac{1}{2}(\boldsymbol{a} - \boldsymbol{b})$

D $\frac{1}{2}(\boldsymbol{a} + \boldsymbol{b})$

TEST YOUR UNDERSTANDING

X is the mid-point for the line MN. What is the position vector of *X*?





$$\overrightarrow{OX} = \overrightarrow{OL} + \overrightarrow{LM} + \overrightarrow{MX}$$

$$\text{but } \overrightarrow{MX} = \frac{1}{2}\overrightarrow{MN}$$

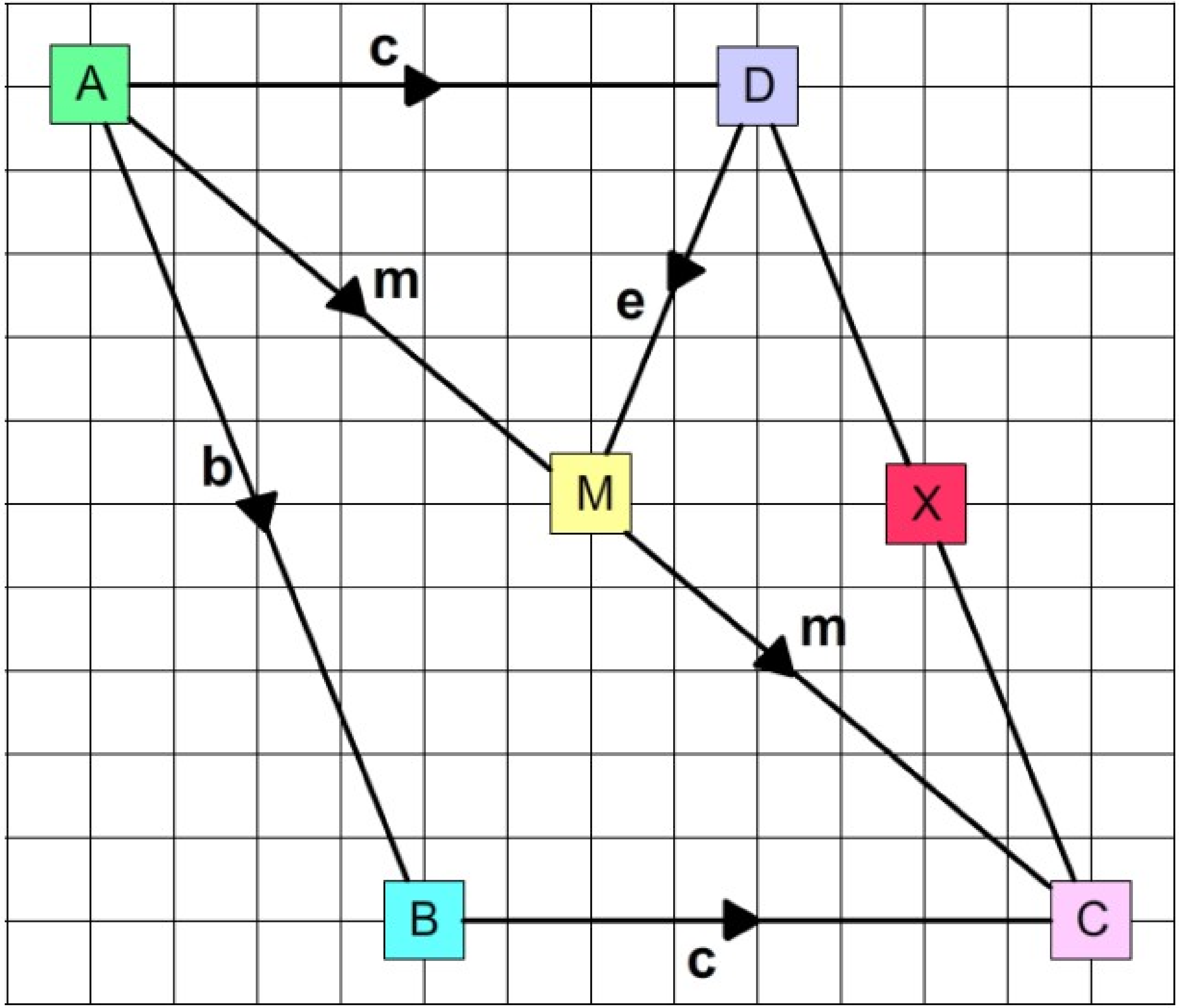
$$\overrightarrow{MN} = -\boldsymbol{b} - \boldsymbol{a} + 3\boldsymbol{b}$$
$$= -\boldsymbol{a} + 2\boldsymbol{b}$$

$$\overrightarrow{OX} = \boldsymbol{a} + \boldsymbol{b} + \frac{1}{2}(-\boldsymbol{a} + 2b)$$
$$= \frac{1}{2}\boldsymbol{a} + 2\boldsymbol{b}$$

vector match

Which routes do these describe?
Match them to the vectors at the bottom.

$c + e + m$	$m - \frac{b}{2}$	$\frac{b}{2}$
$\frac{c - b}{2}$	$b + c - \frac{b}{2}$	$\frac{c}{2} - e$
$b - c$	$c - 2m$	$b - 2m$
$\frac{b + c}{2}$	$m - c - b$	$b + c - m - e$
$\frac{b - c}{2}$	$c + b - c$	



Answers

$\overrightarrow{BX}$	$\overrightarrow{MX}$	$\overrightarrow{DX}$	$\overrightarrow{DM}$	$\overrightarrow{BM}$	$\overrightarrow{DB}$	$\overrightarrow{AM}$
$\overrightarrow{AC}$	$\overrightarrow{AB}$	$\overrightarrow{AD}$	$\overrightarrow{AX}$	$\overrightarrow{CB}$	$\overrightarrow{MA}$	$\overrightarrow{BA}$

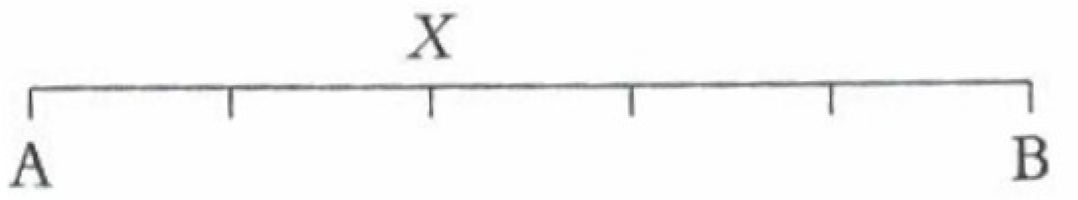
Answers

$c + e + m$	$\overrightarrow{AC}$	$\frac{c}{2} - e$	$\overrightarrow{BX}$	$m - c - b$	$\overrightarrow{MA}$
$m - \frac{b}{2}$	$\overrightarrow{MX}$	$b - c$	$\overrightarrow{DB}$	$b + c - m - e$	$\overrightarrow{AD}$
$\frac{b}{2}$	$\overrightarrow{DX}$	$c - 2m$	$\overrightarrow{BA}$	$\frac{b - c}{2}$	$\overrightarrow{DM}$
$\frac{c - b}{2}$	$\overrightarrow{BM}$	$b - 2m$	$\overrightarrow{CB}$	$c + b - c$	$\overrightarrow{AB}$
$b + c - \frac{b}{2}$	$\overrightarrow{AX}$	$\frac{b + c}{2}$	$\overrightarrow{AM}$		

Vector Geometry - ratios

Ratios can also be used in vector geometry

If X is a point on the line AB such that AX : XB = 2 : 3, label X on the line:

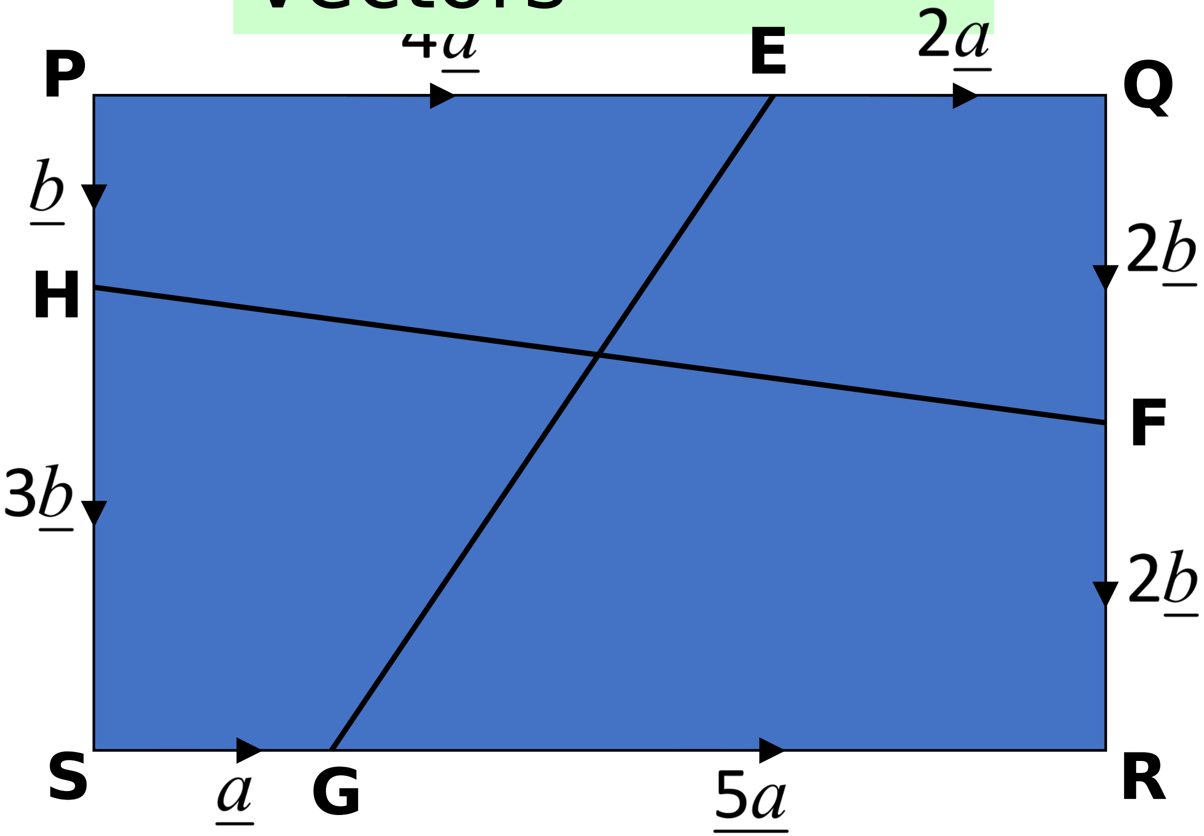


$$\overrightarrow{AX} = \boxed{?}\,\overrightarrow{AB}$$

$$\overrightarrow{XB} = \boxed{?}\,\overrightarrow{AB}.$$

What value have the hidden scalars?

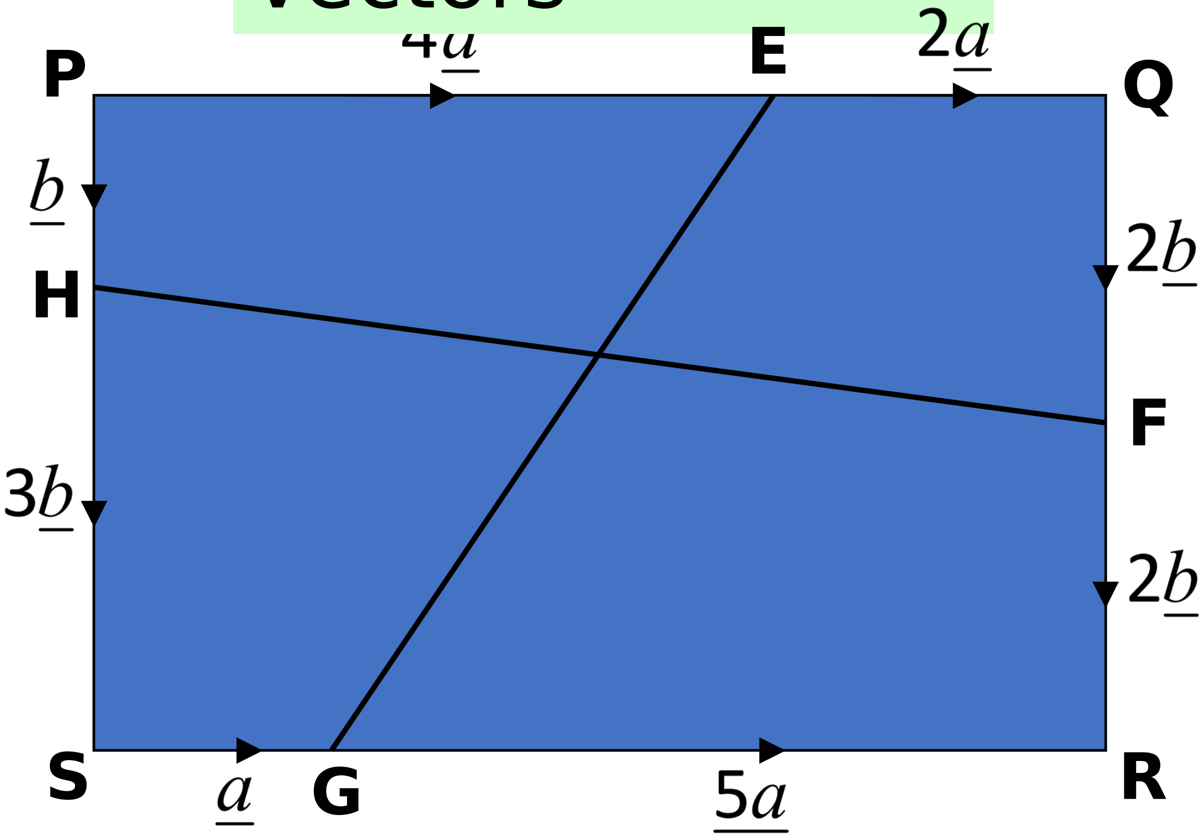
Comparing vectors



On your mini white boards, write down the **ratio of the lengths** of the lines:

$PE : EQ$ $\quad SG : SR$ $\quad PS : HS$ $\quad QF : FR$

Comparing vectors



On your mini white boards, write down the **ratio of the lengths** of the lines:

$PE : EQ$ 2:1 $SG : SR$ 1:5 $PS : HS$ 4:3 $QF : FR$ 1:1

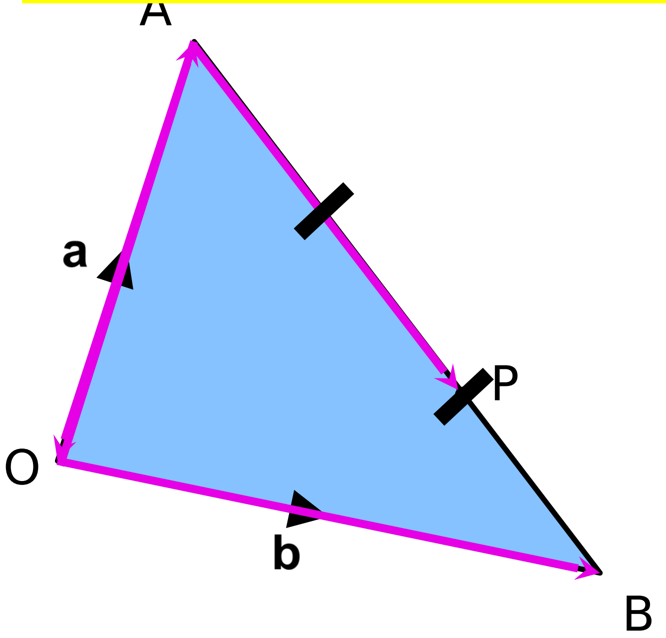
Vector Geometry - ratios

EXAMPLE

First label the diagram with the ratios!

AP : PB = 2 : 1

$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$
Find in terms of $\mathbf{a}$ and $\mathbf{b}$.



a $\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$

$= -\mathbf{a} + \mathbf{b}$

b $\overrightarrow{AP} = \frac{2}{3}\overrightarrow{AB}$

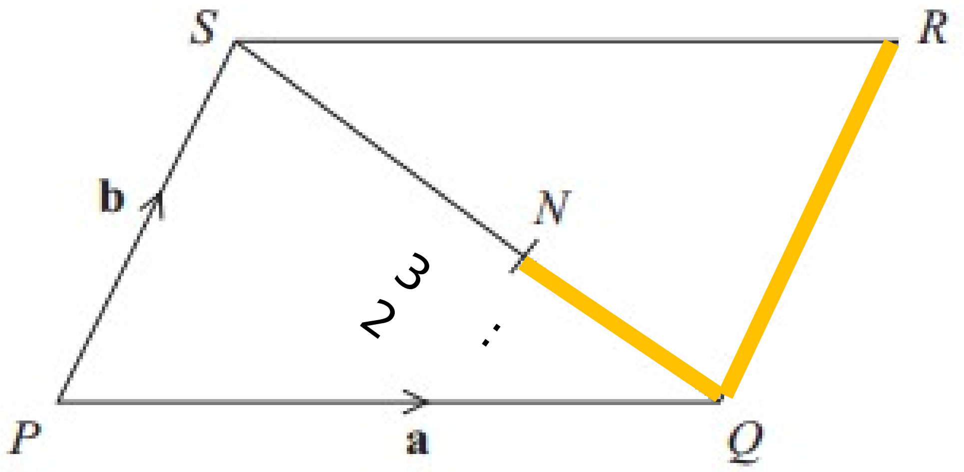
$= \frac{2}{3}(-\mathbf{a} + \mathbf{b})$

c $\overrightarrow{OP} = \overrightarrow{OA} + \overrightarrow{AP}$

$= \mathbf{a} + \frac{2}{3}(-\mathbf{a} + \mathbf{b})$

$= \frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$

Vector Geometry - ratios



PQRS is a parallelogram.
N is the point on *SQ* such that $SN : NQ = 3 : 2$

$\overrightarrow{PQ} = \mathbf{a}$ $\overrightarrow{PS} = \mathbf{b}$

(a) Write down, in terms of **a** and **b**, an expression for $\overrightarrow{SQ}$.

(b) Express $\overrightarrow{NR}$ in terms of **a** and **b**.

a $\overrightarrow{SQ} = -\boldsymbol{b} + \boldsymbol{a}$

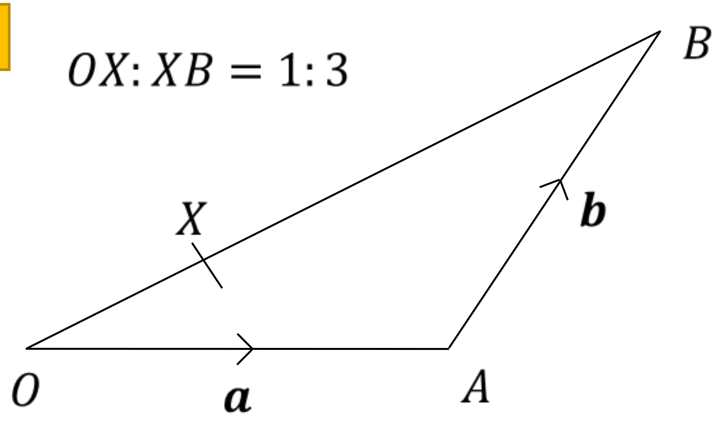
b

?

Test your understanding

A

$OX : XB = 1 : 3$



$\overrightarrow{AX} =$ First Step?

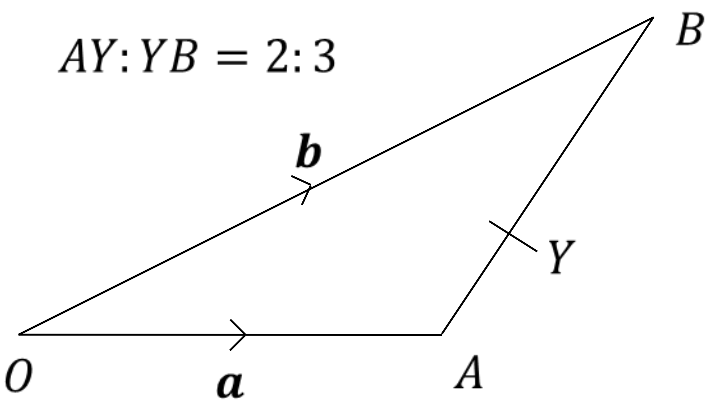
$=$?

$=$

$=$

B

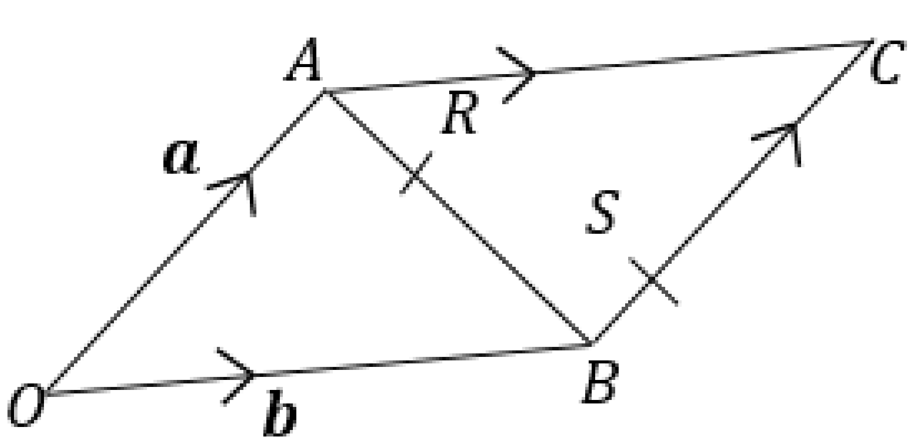
$AY : YB = 2 : 3$



$\overrightarrow{OY} =$ First Step?

?

$OACB$ is a parallelogram. R is a point such that $AR: RB = 2: 3$.
S is a point such that $BS: SC = 1: 3$.



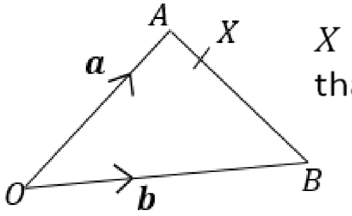
a. $\overrightarrow{OR} =$

b. $\overrightarrow{BS} =$

c. $\overrightarrow{OS} =$

d. $\overrightarrow{RS} =$

1



X is a point such that $AX : XB = 1 : 4$

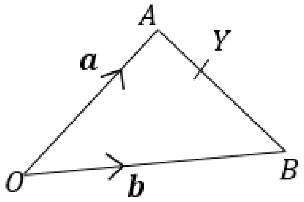
a. $\overrightarrow{AB} =$

b. $\overrightarrow{AX} =$

c. $\overrightarrow{OX} =$

d. $\overrightarrow{BX} =$

2



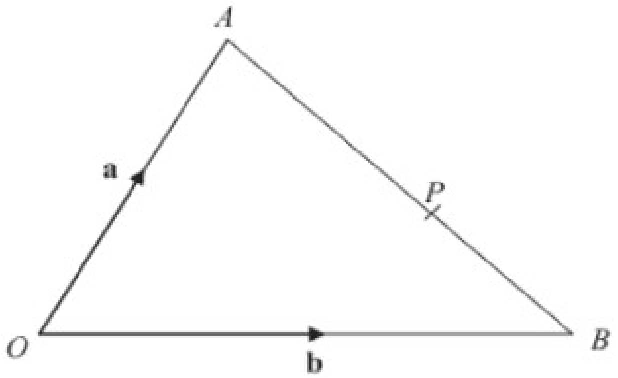
Y is a point such that $YB = 2AY$

a. $\overrightarrow{AY} =$

b. $\overrightarrow{OY} =$

c. $\overrightarrow{YO} =$

3



a) Find $\overrightarrow{AB}$ in terms of $\boldsymbol{a}$ and $\boldsymbol{b}$.

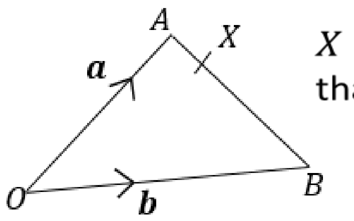
$\overrightarrow{AB} = -\boldsymbol{a} + \boldsymbol{b}$ or $\boldsymbol{b} - \boldsymbol{a}$

b) P is on AB such that $AP : PB = 3 : 2$.

Show that $\overrightarrow{OP} = \frac{1}{5}(2\boldsymbol{a} + 3\boldsymbol{b})$

Quick practice

1



X is a point such that $AX : XB = 1 : 4$

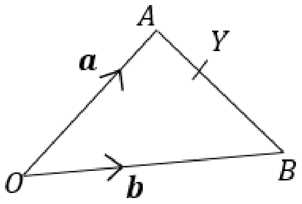
a. $\overrightarrow{AB} =$?

b. $\overrightarrow{AX} =$?

c. $\overrightarrow{OX} =$?

d. $\overrightarrow{BX} =$?

2



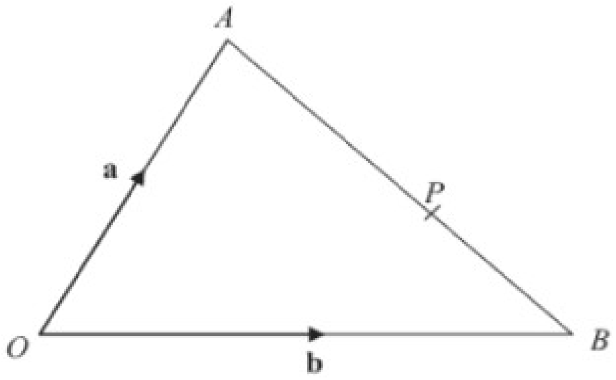
Y is a point such that $YB = 2AY$

a. $\overrightarrow{AY} =$?

b. $\overrightarrow{OY} =$?

c. $\overrightarrow{YO} =$?

3



a) Find $\overrightarrow{AB}$ in terms of $\boldsymbol{a}$ and $\boldsymbol{b}$.

?

b) P is on AB such that $AP : PB = 3 : 2$.

Show that $\overrightarrow{OP} = \frac{1}{5}(2\boldsymbol{a} + 3\boldsymbol{b})$

?

Exam style question

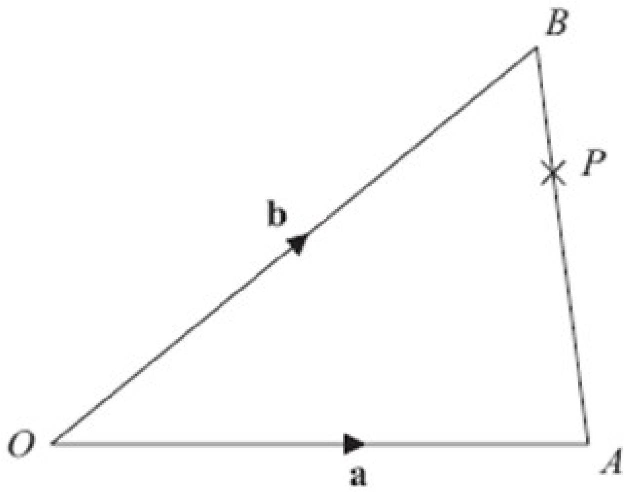


Diagram **NOT** accurately drawn

OAB is a triangle.

$\overrightarrow{OA} = \mathbf{a}$
$\overrightarrow{OB} = \mathbf{b}$

(a) Find $\overrightarrow{AB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

?

....

(1)

P is the point on AB such that $AP : PB = 3 : 1$

(b) Find $\overrightarrow{OP}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.
Give your answer in its simplest form.

?

.....

You MUST expand and simplify.

All together

Q 5

OPQR is a trapezium.

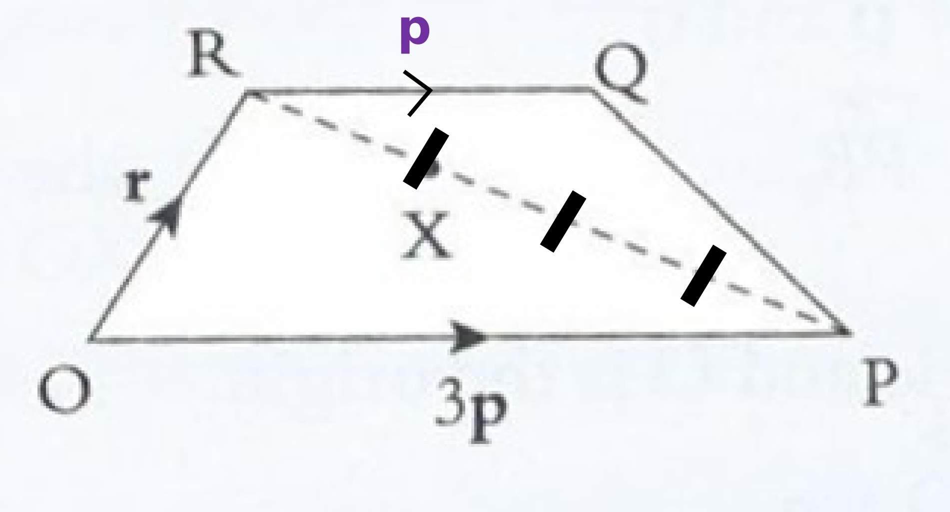
$\overrightarrow{OP} = 3\mathbf{p}$ and $\overrightarrow{OR} = \mathbf{r}$

$\overrightarrow{RQ} = \frac{1}{3}\overrightarrow{OP}$

X lies on RP such that $RX : XP = 1 : 3$

➡ **NOTE:** RX : XP = 1 : 3 means that $\overrightarrow{RX} = \frac{1}{4}\overrightarrow{RP}$.

First label the diagram with the ratios!



a Find in terms of **p** and **r**

i $\overrightarrow{OQ}$, ii $\overrightarrow{RP}$, iii $\overrightarrow{RX}$, iv $\overrightarrow{OX}$.

b What do your answers for $\overrightarrow{OQ}$ and $\overrightarrow{OX}$ tell you about the points O, X and Q?

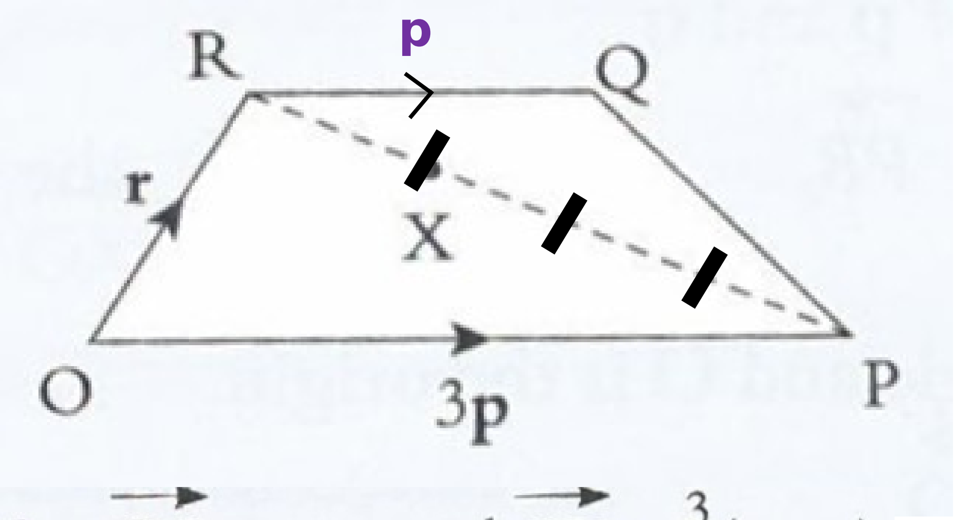
SOLUTION

a i $\overrightarrow{OQ} = \overrightarrow{OR} + \overrightarrow{RQ}$
$= \mathbf{r} + \mathbf{p}$

ii $\overrightarrow{RP} = \overrightarrow{RO} + \overrightarrow{OP}$
$= -\mathbf{r} + 3\mathbf{p}$

iii $\overrightarrow{RX} = \frac{1}{4}\overrightarrow{RP}$
$= \frac{1}{4}(-\mathbf{r} + 3\mathbf{p})$
$= \frac{3}{4}\mathbf{p} - \frac{1}{4}\mathbf{r}$

iv $\overrightarrow{OX} = \overrightarrow{OR} + \overrightarrow{RX} = \mathbf{r} + \frac{3}{4}\mathbf{p} - \frac{1}{4}\mathbf{r}$
$= \frac{3}{4}\mathbf{r} + \frac{3}{4}\mathbf{p}$
$= \frac{3}{4}(\mathbf{r} + \mathbf{p})$



b $\overrightarrow{OQ} = \mathbf{r} + \mathbf{p}$ and $\overrightarrow{OX} = \frac{3}{4}(\mathbf{r} + \mathbf{p})$
So $\overrightarrow{OX} = \frac{3}{4}\overrightarrow{OQ}$

This means that OX and OQ are **parallel.**
The points O lies on both of these line segments.
So the points O, X and Q are **collinear.**

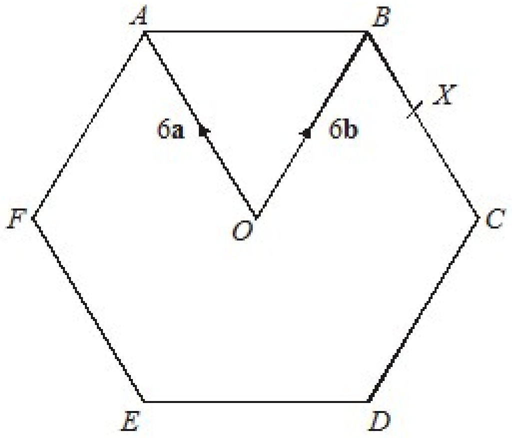


Diagram **NOT** accurately drawn

The diagram shows a regular hexagon *ABCDEF* with centre *O*.

$\overrightarrow{OA} = 6\mathbf{a}$ $\overrightarrow{OB} = 6\mathbf{b}$

(a) Express in terms of **a** and/or **b**

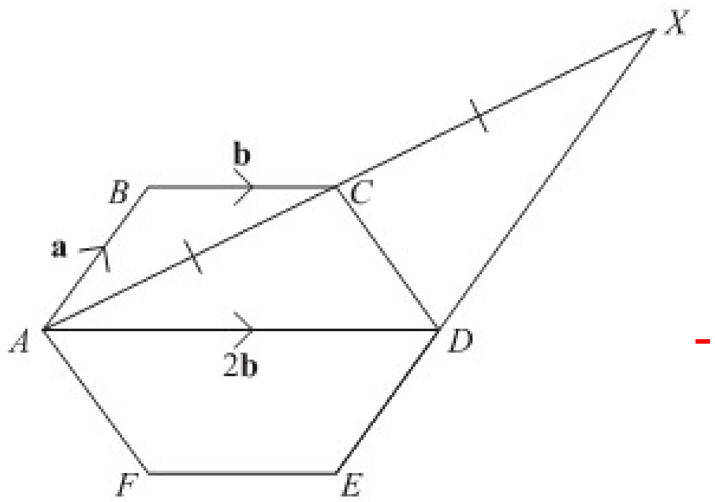
(i) $\overrightarrow{AB}$,

....

(ii) $\overrightarrow{EF}$.

X is the midpoint of *BC*.

(b) Express $\overrightarrow{EX}$ in terms of **a** and/or **b**



DX

$-2\mathbf{b} + \mathbf{a} + \mathbf{b} + \mathbf{a} + \mathbf{b}$

$2\mathbf{a}$

Diagram **NOT**
accurately drawn

ABCDEF is a regular hexagon.

$\overrightarrow{AB} = \mathbf{a}$ $\quad \overrightarrow{BC} = \mathbf{b}$ $\quad \overrightarrow{AD} = 2\mathbf{b}$

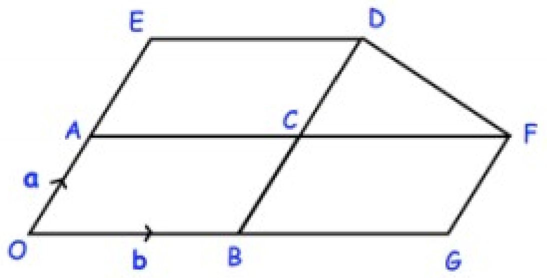
(a) Find the vector $\overrightarrow{AC}$ in terms of **a** and **b**. $\mathbf{a} + \mathbf{b}$

$\overrightarrow{AC} = \overrightarrow{CX}$

(b) Prove that *AB* is parallel to *DX*.

1. In the diagram OBDE and OAFG are parallelograms.
B is the midpoint of OG.
A is the midpoint of OE.

$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$



(a) Express, in terms of **a** and **b**, the following vectors.
Give your answers in their simplest form.

(i) $\overrightarrow{OC}$

$\underline{a} + \underline{b}$
(1)

(ii) $\overrightarrow{BA}$

$\underline{a} - \underline{b}$
(1)

(iii) $\overrightarrow{DF}$

$\underline{b} - \underline{a}$
(1)

(b) Show $\overrightarrow{EG}$ and $\overrightarrow{DF}$ are parallel.

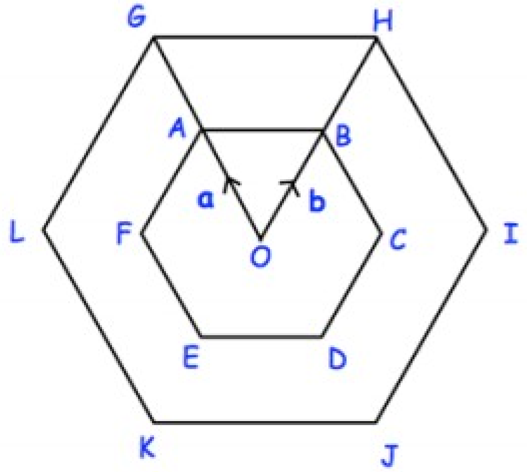
$\overrightarrow{EG} = 2\underline{b} - 2\underline{a}$

$\overrightarrow{DF} = \underline{b} - \underline{a}$

$\overrightarrow{EG} = 2\overrightarrow{DF}$

$\therefore$ they are parallel
(2)

2.



ABCDEF and GHIJKL are regular hexagons with centre O.
GHIJKL is an enlargement of ABCDEF, with scale factor 2.

$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$

(a) Write the vector $\overrightarrow{AB}$ in terms of **a** and **b**.

$\underline{b} - \underline{a}$ ....

(1)

(b) Write the vector $\overrightarrow{OG}$ in terms of **a** and **b**.

$2\underline{a}$ ....

(1)

(c) Write the vector $\overrightarrow{OE}$ in terms of **a** and **b**.

$-\underline{b}$ ....

(1)

(d) Write the vector $\overrightarrow{FC}$ in terms of **a** and **b**.

$2\underline{b} - 2\underline{a}$ ....

(1)

(e) Write the vector $\overrightarrow{IK}$ in terms of **a** and **b**.

$2\underline{a} - 4\underline{b}$ ....

(1)

(f) Write the vector $\overrightarrow{LI}$ in terms of **a** and **b**.

$4\underline{b} - 4\underline{a}$ ....

(1)

(g) Write the vector $\overrightarrow{LG}$ in terms of **a** and **b**.

$2\underline{b}$ ....

(1)

(h) Write the vector $\overrightarrow{JG}$ in terms of **a** and **b**.

$4\underline{a}$ ....

(1)

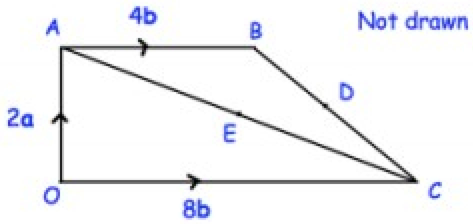
(i) Write the vector $\overrightarrow{DL}$ in terms of **a** and **b**.

$3\underline{a} - 2\underline{b}$ ....

(1)

3. OABC is a trapezium.
Point D is the midpoint of BC.
Point E is the midpoint of AC.

$\overrightarrow{OA} = 2\mathbf{a}$ $\quad\overrightarrow{AB} = 4\mathbf{b}$ and $\overrightarrow{OC} = 8\mathbf{b}$



Not drawn accurately

(a) Write these vectors in terms of **a** and **b**.

(i) $\overrightarrow{OB}$

$2\underline{a} + 4\underline{b}$ **(1)**

(ii) $\overrightarrow{AC}$

$8\underline{b} - 2\underline{a}$ **(1)**

(iii) $\overrightarrow{AE}$

$4\underline{b} - \underline{a}$ **(1)**

(b) Show $\overrightarrow{ED}$ and $\overrightarrow{OC}$ are parallel.

$\overrightarrow{OC} = 8\underline{b}$

$\overrightarrow{ED} = \underline{a} - 4\underline{b} + 4\underline{b} + \frac{1}{2}(-4\underline{b} - 2\underline{a} + 8\underline{b})$

$\overrightarrow{ED} = \underline{a} - 4\underline{b} + 4\underline{b} - 2\underline{b} - \underline{a} + 4\underline{b}$

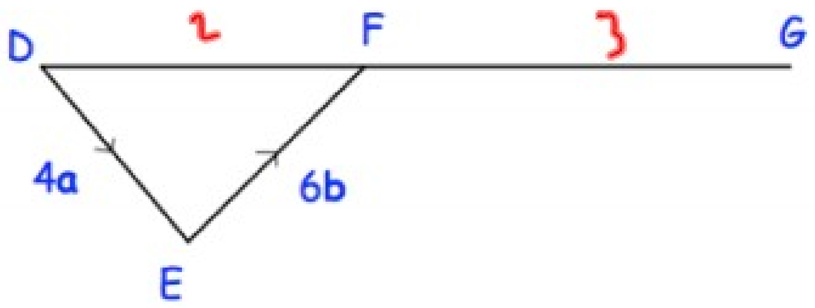
(3)

$\overrightarrow{ED} = 2\underline{b}$ $\quad\overrightarrow{OC} = 4\overrightarrow{ED}$

$\therefore$ parallel

4. DFG is a straight line.

$\overrightarrow{DE} = 4a$ and $\overrightarrow{EF} = 6b$



(a) Write down the vector $\overrightarrow{DF}$ in terms of **a** and **b**

$4\underline{a} + 6\underline{b}$

(1)

(b) DF : FG = 2:3

Work out the vector $\overrightarrow{DG}$ in terms of **a** and **b**
Give your answer in its simplest form.

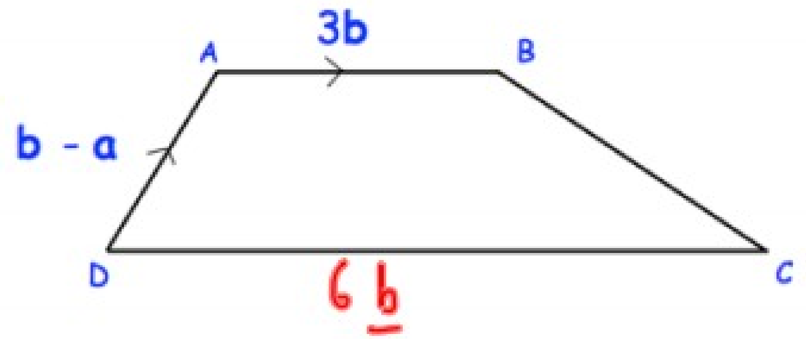
$(2\underline{a} + 3\underline{b}) \times 5$

$10\underline{a} + 15\underline{b}$

....

(2)

5. ABCD is a trapezium



AB and DC are parallel.
DC = 2AB

(a) Write down the vector $\overrightarrow{DC}$ in terms of **a** and **b**

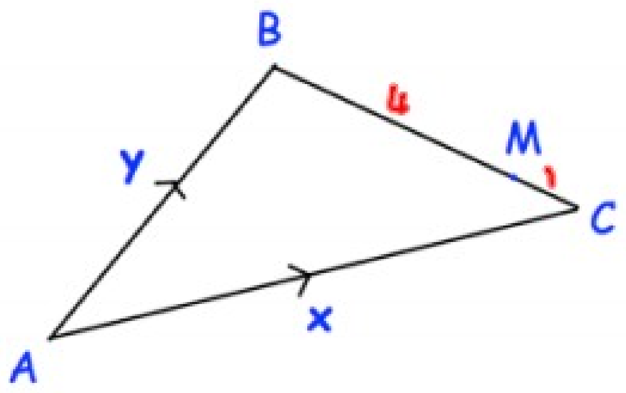
$6\underline{b}$
(1)

(b) Work out the vector $\overrightarrow{BC}$ in terms of **a** and **b**
Give your answer in its simplest form.

$-3\underline{b} - \underline{b} + \underline{a} + 6\underline{b}$

$2\underline{b} + \underline{a}$
(2)

6.



ABC is a triangle.

M lies on BC such that BM = $\frac{4}{5}$ BC

Express these vectors in terms of **x** and **y**

(a) $\overrightarrow{BC}$

$-\underset{\sim}{y} + \underset{\sim}{x}$ **(1)**

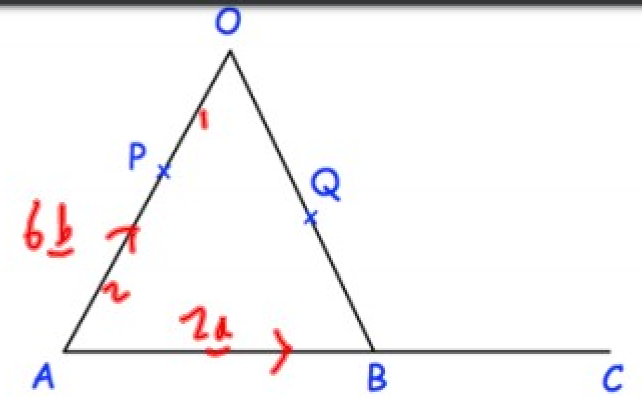
(b) $\overrightarrow{BM}$

$-\frac{4}{5}\underset{\sim}{y} + \frac{4}{5}\underset{\sim}{x}$ **(1)**

(c) $\overrightarrow{AM}$

$\underset{\sim}{y} - \frac{4}{5}\underset{\sim}{y} + \frac{4}{5}\underset{\sim}{x}$

$\frac{1}{5}\underset{\sim}{y} + \frac{4}{5}\underset{\sim}{x}$ **(1)**



AOB is a triangle.
P is a point on AO.

$\overrightarrow{AB} = 2a$ $\overrightarrow{AO} = 6b$ AP:PO = 2:1

(a) Find the vector $\overrightarrow{OB}$ in terms of **a** and **b**

$2\underline{a} - 6\underline{b}$ ....
(1)

Q is the midpoint of OB.
B is the midpoint of AC.

(b) Show PQC is a straight line.

$\overrightarrow{PQ} = 2\underline{b} + \underline{a} - 3\underline{b}$

$\overrightarrow{PQ} = \underline{a} - \underline{b}$

$\overrightarrow{QC} = 3\overrightarrow{PQ}$

$\overrightarrow{QC} = \underline{a} - 3\underline{b} + 2a$

$\overrightarrow{QC} = 3\underline{a} - 3\underline{b}$

QC and PQ are parallel and also both pass through the point Q, therefore PQC must be a straight line. (co-linear)

(3)

4.

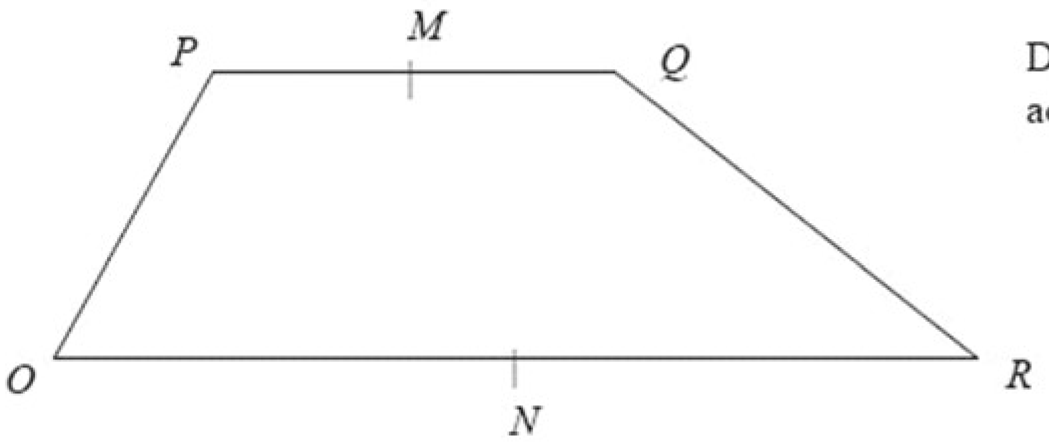


Diagram **NOT** accurately drawn

OPQR is a trapezium with *PQ* parallel to *OR*.

$\overrightarrow{OP} = 2\mathbf{b}$ $\overrightarrow{PQ} = 2\mathbf{a}$ $\overrightarrow{OR} = 6\mathbf{a}$

M is the midpoint of *PQ* and *N* is the midpoint of *OR*.

(a) Find the vector $\overrightarrow{MN}$ in terms of **a** and **b**.

X is the midpoint of *MN* and *Y* is the midpoint of *QR*.

(b) Prove that *XY* is parallel to *OR*.

4.

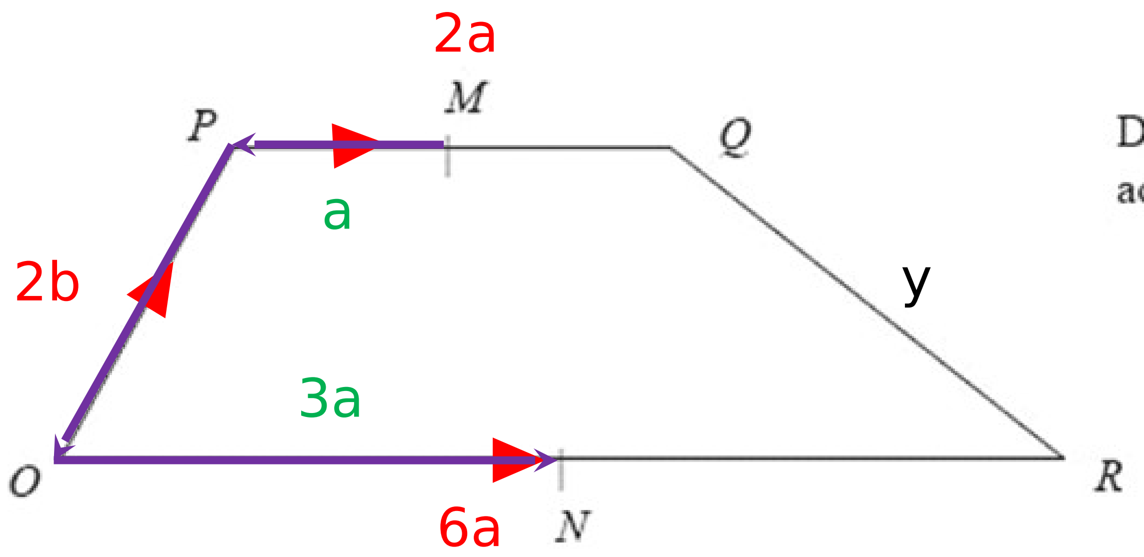


Diagram **NOT** accurately drawn

OPQR is a trapezium with *PQ* parallel to *OR*.

$\overrightarrow{OP} = 2\mathbf{b}$ $\overrightarrow{PQ} = 2\mathbf{a}$ $\overrightarrow{OR} = 6\mathbf{a}$

- a - 2b + 3a

2a – 2b

M is the midpoint of *PQ* and *N* is the midpoint of *OR*.

(a) Find the vector $\overrightarrow{MN}$ in terms of **a** and **b**.

X is the midpoint of *MN* and *Y* is the midpoint of *QR*.

(b) Prove that *XY* is parallel to *OR*.

4.

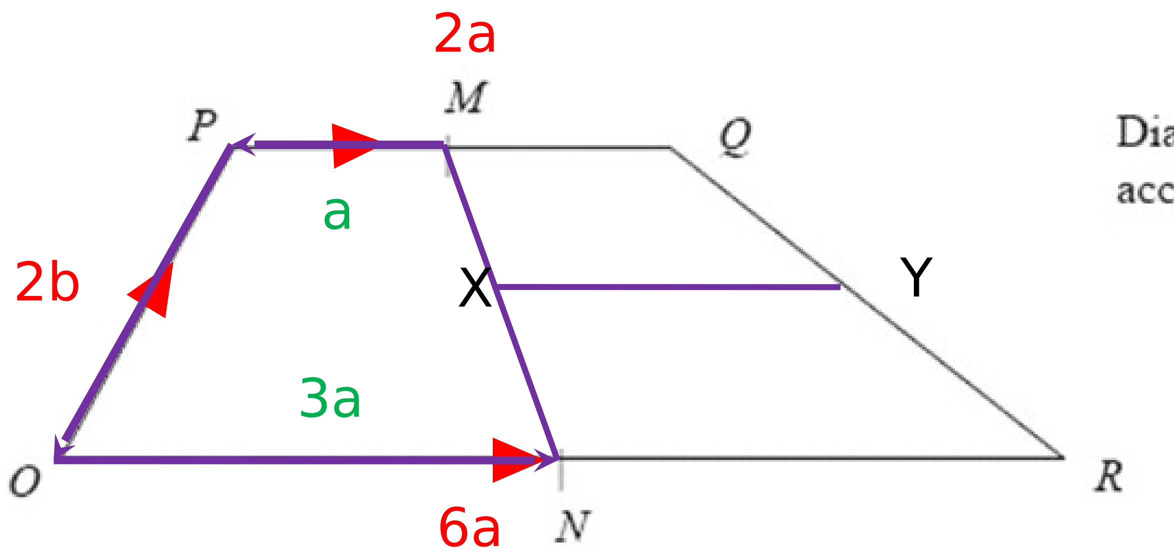


Diagram **NOT** accurately drawn

OPQR is a trapezium with *PQ* parallel to *OR*.

$\overrightarrow{OP} = 2\mathbf{b}$ $\quad\quad \overrightarrow{PQ} = 2\mathbf{a}$ $\quad\quad \overrightarrow{OR} = 6\mathbf{a}$

M is the midpoint of *PQ* and *N* is the midpoint of *OR*.

2a – 2b

(a) Find the vector $\overrightarrow{MN}$ in terms of **a** and **b**.

X is the midpoint of *MN* and *Y* is the midpoint of *QR*.

(b) Prove that *XY* is parallel to *OR*.

1st Work out QR

-2a -2b + 6a

4a - 2b

QY will be half this

2a - b

Find XY

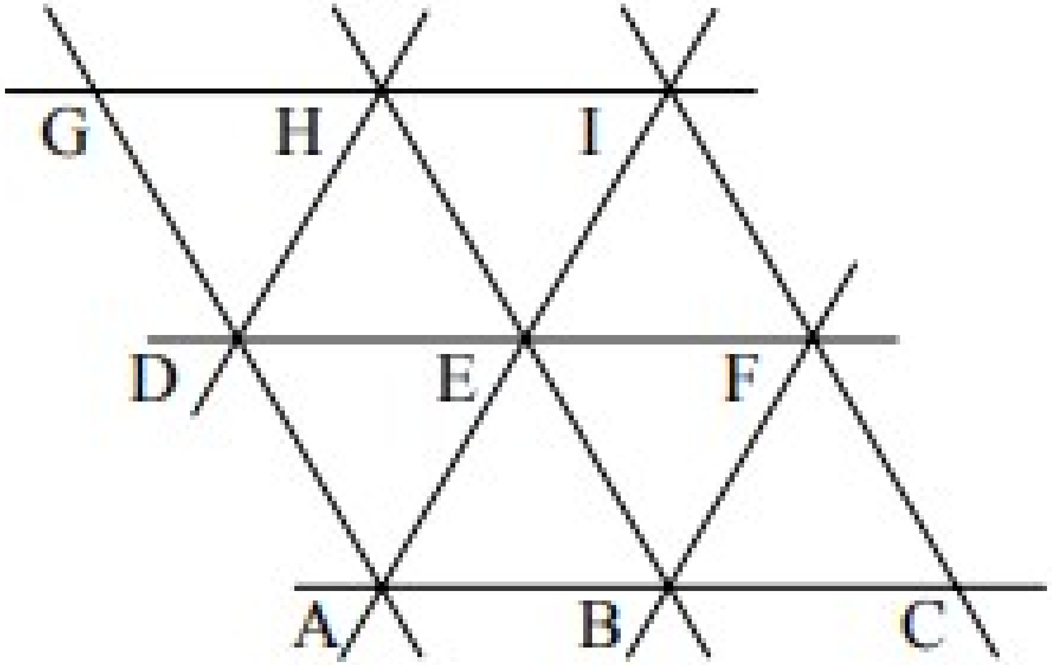
XM = ½ -(2a – 2b)

XM = -a + b

XY = -a + b + a + 2a - b

XY = 2a

$\overrightarrow{AC} = \underline{s}$ and $\overrightarrow{AD} = \underline{t}$



What could the question be?